# VENUS TOPOGRAPHY BOX

Venus is a rocky planet about the same size as the Earth. Yet we cannot see its surface, even form an orbiting spacecraft, because Venus is completely shrouded in clouds. We expect that it is much like the Earth, with mountain ranges, deep canyons and volcanoes. If we could "see" the surface, we would be able to learn more about how their features form both on Venus and the Earth.

Radar signals can penetrate the cloud cover. Radar signals transmitted from an orbiting spacecraft and reflected from the surface back to the spacecraft can be used to map the surface. By timing the radar pulses accurately, the distance between the spacecraft and a point on a surface can be determined. We call this measuring method radar altimetry. The Magellan spacecraft, placed in orbit around Venus in August 1990, has used radar altimetry to make a topographical map of the planet's surface.

In this exercise, students learn how to use altimetry to map the topography of a "planet" whose surface is hidden from view.

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**STUDENTS WILL LEARN ABOUT**:
Topography
Remote Sensing and Measuring
Surface Features
Mapping
Magellan Spacecraft
Research Techniques

**SKILLS USED:**
Modeling
Measuring
Gathering and Recording
Estimating
Predicting
Interpreting

Inferring
Questioning Anomalies
Need to Refine Measurements
Working from a Non-Earth Based Perspective
(i.e., largest measurement is lowest point)

**PRIMARY OBJECTIVES:**

1. Students will learn how to measure the topography of a given area.

2. Students will learn how to make a contour map.

**SECONDARY OBJECTIVES:**

1. Students will learn about remote sensing and measuring.

2. Students will learn about surface features.

3. Students will learn about research techniques.

**KEY QUESTION:**

Where can I land my multi-million dollar spacecraft safely in a 3 x 3 square?

**MATERIALS:**

Large shoebox
Newspaper
Aluminum foil
Plaster of Paris
Nail, ice pick, awl Ruler
Skewer, chopstick, thin pencil
Graph paper (Appendix 2)
Colored pencils, markers, crayons Color Key (Appendix 1)

**TEACHER PREPARATION:**

Prepare one box for every 3 to 5 students

1. Crumple newspaper, and place on the bottom of a large shoe box.

2. Cover newspaper with aluminum foil to create a surface with varied topography.

3. Prepare Plaster of Paris and pour over the foil in the box.

4. Mark grid on the top of the lid of the shoe box, each block measuring
1" x 1", A1 through H11.

5. Punch one hole in each block using the nail, ice pick or awl.

6. Tape the lid onto the shoe box.

**CLASS PREPARATION:**

1. Students will work in small groups of 3-5. Each group is given a topography box, measuring stick, and blank grid.

2. Tell the students they represent a scientific research team specializing in radar mapping. NASA wants to land a spacecraft on an unseen (cloud-covered) area of Venus. Their job is to decide the best place for the spacecraft to land.

3. Describe how to insert the measuring stick and record data on the grid sheet. Do one measurement together. For young students, the measuring stick can be color-coded. The appropriate grid square is then colored by the students. For older students, the measurement in centimeters can be recorded on the grid and subsequently colored according to the color key.

4. While students are working, be sure tasks are being shared, data are in correct squares, etc. Is a small measurement a high spot or low spot? Are patterns developing (e.g. valleys, cliffs, etc.)?

5. Once all measurements have been recorded and the squares on the grid sheet colored, show the students how to group their height measurements into a topographical map by drawing contour lines around the blocks of each color. Practice identifying features

(mountains, valleys, plateaus, etc.) on the maps.

6. Discuss the choice of landing sites. What criteria did the students use? What is the scale of the map? Is a flat area necessarily smooth; i.e., might the area be strewn with boulders not detected by the altimetry measurements?

7. Discuss the real-life problems of deciding where to land on the Moon, Mars, or Venus. The scientists want to land at an exciting site (ancient river valley, near a volcano, etc.) so they can learn as much as possible, whereas the engineers want to land in a smooth, flat place to assure the safety of the spacecraft and crew, even if it is less interesting, scientifically.

8. Now it is time to open the boxes and compare the students' maps with the true topography!

**FOLLOW-UP QUESTIONS:**

1. How could we make measurements more precise?
[Have more holes closer together (1/2" apart rather than 1").]

2. Where else could we use this technique for map-making?
[Other planets and their moons; ocean floors]

**FOLLOW-UP ACTIVITIES:**

1. Learn how to read a topographic map; study a topographic map of your area.

2. Examine radar images of Venus from the Magellan spacecraft and find out what scientists have learned about Venus.

3. Understand how the formula, rate x time = distance, is used to make a radar map. (The radar signal travels at the speed of light, 3 x 105 km/sec.)

4. Learn how animals such as dolphins or bats use a similar distance-finding technique to "map" their surroundings.